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Patentanmeldung Nr. Patent application No. Demande de brevet n°

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Bezeichnung der Erfindung/Title of the invention/Titre de l'invention:
(Falls die Bezeichnung der Erfindung nicht angegeben ist, siehe Beschreibung.
If no title is shown please refer to the description.
Si aucun titre n'est indiqué se referer à la description.)

Danner-pipe

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53
30. Okt. 2003

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Danner Pipe

The present invention relates to a mandrel for producing glass tubes or rods, particularly for the Vello process, the A-drawing process and preferably for the Danner process.

A common used process for manufacturing glass tubes or rods is the Vello process. The melt flows around a mandrel, the Vello needle, the corresponding drawing tool of this process. Here, the glass is formed into a tube. The procedure is further performed with air blown into the tube. The tube first flows perpendicularly downward, it is then diverted horizontally and drawn off via a gravity-roller conveyor (as in the Danner process) cooled and cut to length.

Also in the A-drawing process (down-draw process), the glass melt already flows in tube form from the feeder. It flows over the drawing tool, a mandrel, here an A-drawing needle, where the glass is formed into a tube. Also in this process, the operation can be performed with air. The tube flows perpendicularly downward and is cut to length without deflection at temperatures of about 300° C.

The Danner Process was developed for the continuous production of glass tubing and rod. In the Danner process, a slightly tilted, slowly rotating tube, the Danner mandrel, on which a continuous strand of glass melt accumulates, is used as a drawing tool. At the lower end of the mandrel, the head of the mandrel, the glass is drawn off under the formation of the "bulb," whereby a cavity is formed by supplying air or gas through the hollow shaft of the mandrel. After deflection to the horizontal, the solidified tube passes through a gravity-roller conveyor to the drawing machine, behind which separation into tube sections is carried out by chopping. A further coating of the inner side of the tube is described in the patent application US 6595029, which relates to coated mandrel, and which is herewith incorporated by reference.

Since the temperatures for the above describes processes operate at very high temperatures, the mandrel has to be heat-resistant. Furthermore, the temperature gradient between the rear end of the mandrel, particularly the Danner blowpipe, where the glass is dispensed to the

mandrel and the front end where the glass is removed or pulled away is in the range of 300-400K. Typical ceramic mandrels or mandrels with a ceramic surface provide only a very short lifetime which depends on the glass type and the processing temperature. Furthermore, the use of ceramic mandrels impure the glass tubes. Alternatives, with ceramic mandrels coated or covered with stainless steel lead to high stressing forces between the different materials, which may result in buckling or warping of the surface, especially for composite products with different thermal expansion coefficients

It is therefore an object of the invention to provide an improved mandrel and a respective method. This object is achieved with the respective claims.

It is an advantage to provide a mandrel with metal a surface comprising platinum materials which are heat resistant, wherein undesired stressing forces due to different thermal expansions are avoided.

Since the above described production processes for glass tubes or rods require high temperatures that put extreme chemical and physical stress on all system components, the present invention uses preferably platinum materials, which have the advantage of being much more resistant than ceramic materials. Systems made of platinum materials allow continuous glass production under uniformly good conditions over many months and years. This means long life spans, high economic efficiency and excellent glass quality. It can be distinguish between Pt, Pt alloys and FKS* Pt ("FKS" = German abbreviation for FeinKornStabilisiert = dispersion hardened) materials which can also be used for the coating of special ceramic components. The use of platinum provides further the following advantages: no contamination of the melted glass due to soluble and non-soluble foreign materials; high chemical resistance against aggressive glass melts (e.g., color enamels, special glasses); better chemical homogeneity of the melted glass; processing-suitable homogeneity of the melted glass due to great flexibility in the working temperature (up to approximately 1650° C). Furthermore, precise forming and constant quantity specifications for processing is possible due to the high precision of the platinum components.

The mandrel according to the present invention has superior resistance to erosion by molten glass by composing the surface of a mandrel for glass tube forming, which is to be in contact with molten glass.

The present invention will be further described with reference to the accompanying drawings wherein like parts have the same reference signs, wherein:

FIG. 1 is a side view of a first embodiment of the present invention;

FIG. 2 is a side view of a second embodiment of the present invention;

FIG. 3 a side view of another embodiment of the present invention; and

FIG. 4 a side view of a further embodiment of the present invention.

Referring now to the drawing, there is shown in Fig. a mandrel 42 according to a first aspect of the invention. The mandrel 42 comprises a body 1 made of ceramic composite material which is surrounded by an external metal material jacket 2 surrounding at least a portion, preferably a major portion of said ceramic composite material body 1. The ceramic composite material body 1 has substantially the similar thermal expansion coefficient as the metal material of the jacket 2. Since the preferred metal material is from the group of PGM (platinum group material), and more preferably of FKS platinum, the used ceramic composite material has a substantially the similar thermal expansion coefficient like the above platinum. Examples for ceramic materials having a adjustable coefficient of thermal expansion coefficient are: spinell materials comprising $MgO\text{-}MgAl_2O_4$. This ceramic composite materials could be bonded materials or casting slip materials with thermal expansion coefficients α between $9x10^{-6}K^{-1}$ – $15x10^{-6}K^{-1}$ more preferably $10x10^{-6}K^{-1}$-$12x10^{-6}K^{-1}$. The body 1 and the metal jacket 2 of the embodiment in Fig. 1 has preferably a cylindrical shape at the rear and comprises a portion with a conical shape at the front end which assists the drawing process at the front end.

As can be seen in Fig.1 to Fig 4, these examples of embodiments of a mandrel according to the invention are axially symmetrical along their longitudinal axis X. Furthermore, theses displayed embodiments comprise a tube 3 with an inner hollow channel for blowing gas through them, which assists the tube producing process or allows the treating of the inner surface of the tube with special gases. Another possibility for treating the inner surface of the glass tube is the coating of the metal jacket 2 which upon contact with an inside of the surface for the tube being produced is released and accumulates on the inside surface, thereby providing a coating onto the glass surface. Since the mandrel is rotating in the Danner process, all the embodiments shown in Fig. 1 to 4 comprise bearings, which allow a rotation of the mandrel around its longitudinal axis 10. The front end and the rear end are defined for all embodiments shown with respect to the flow direction of the glass. The mandrels comprise preferably a fixed bearing 4 at the front portion of the mandrel, and floating bearing 5 at the rear end. Due to the floating bearing 5, the mandrel can expand along its longitudinal axis without producing undesired stressing forces. The first embodiment, depicted in Fig. 1 comprises further a biasing means 6 in form of a spring, which ensures a tight fit between the body1 and the metal jacket 2.

Fig. 2 relates to a second embodiment of the present invention, wherein due to the self-supporting construction no ceramic body inside the metal jacket 22 is needed. The self-supporting metal jacket 22 has a metal layer which is stiff enough to resist the heat and forces during the glass producing process. The stiffness is further enhanced by an additional inner self-supporting structure, which could be support struts or thrust rings 21.

This embodiment advantageously allows that thermally insulation material is introduced between the tube 3 and the metal jacket 22, which provides a much better insulation than ceramic materials.

In the embodiment in Fig. 3, the self-supporting inner structure of the mandrel is an embossed or corrugated plate, wherein the material is substantially similar to the material of which the metal jacket is made.

Another preferred embodiment of a self-supporting mandrel is depicted in Fig. 4. In this embodiment, the mandrel is formed, so that the diameters of the mandrel from the rear end to the front end are either conical or equally decreasing.

The detailed description above is intended only to illustrate certain preferred embodiments of the present invention. It is in no way intended to limit the scope of the invention as set out in the claims.

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53
30. Okt. 2003

Claims

1. An mandrel for producing a glass tube or rod, comprising,

a body (1) comprising a ceramic composite material, and

an external metal material jacket (2) surrounding at least a portion of said body,

wherein the ceramic composite material has a substantially similar thermal expansion coefficient as the metal material of said jacket.

2. The mandrel according to claim 1, wherein the ceramic composite material is a bonded material.

3. The mandrel according to claim 1 or 2, wherein the ceramic composite material is a casting slip material.

4. The mandrel according to claim 1, 2 or 3, wherein the ceramic composite comprises $MgO\text{-}MgAl_2O_4$.

5. The mandrel according to any of the preceding claims, wherein the body (1) and the metal jacket (2) comprise at least a portion with an essentially cylindrical shape.

6. The mandrel according to any of the preceding claims, wherein the body and the metal jacket comprise at least a portion with conical shape.

7. The mandrel according to any of the preceding claims, wherein the entire body (1) and the metal jacket (2) comprise a conical shape.

8. The mandrel according to any of the preceding claims, wherein the body (1) and the metal jacket (2) is cylindrical at the rear end portion and conical at the front end portion.

9. A mandrel for producing a glass tube or rod, comprising a self-supporting metal material jacket (22).

10. The mandrel according to claim 9, wherein the self-supporting metal jacket (22) comprises an outer wall and an inner self-supporting structure.

11. The mandrel according to claim 10, wherein the inner self-supporting structure comprises at least one support strut.

12. The mandrel according to claim 10, wherein the inner self-supporting structure comprises at least one thrust or annular ring.

13. The mandrel according to claim 10, 11 or 12, wherein the inner supporting structure is an embossed or corrugated plate made of a metal material substantially similar to the metal material of the outer wall.

14. The mandrel according to any of the preceding claims, wherein the mandrel (42) is axially symmetrical along its longitudinal axis.

15. The mandrel according to any of the preceding claims, wherein the mandrel (42) is a Vello needle, an A-flow or A-drawing needle or preferably a Danner blowpipe/tube or Danner sleeve.

16. The mandrel according to any of the preceding claims, wherein the mandrel (42) provides an inner channel for blowing gas through and allows treating the inside surface of the glass tube with at least one gas.

17. The mandrel according to any of the preceding claims, wherein the metal material comprises a PGM material.

18. The mandrel according to any of the preceding claims, wherein the metal material comprises platinum alloy.

19. The mandrel according to any of the preceding claims, wherein the metal material comprises FKS16 platinum alloy.

20. The mandrel according to any of the preceding claims, wherein the metal material jacket comprises a coating which upon contact with an inside surface of the tube being produced is released and accumulates on the inside surface to form a coating on the tube.

21. The mandrel according to any of the preceding claims, wherein the mandrel (42) has a front end and a rear end with respect to the flow direction of the glass material and wherein the diameters from the rear end to the front end are conical equal or decreasing.

22. The mandrel according to any of the preceding claims, wherein the mandrel (42) comprises essentially at the front end a fixed bearing adapted to rotate the mandrel around said axis.

23. The mandrel according to any of the preceding claims, wherein the mandrel (42) comprises essentially at the rear end a floating bearing, adapted to rotate the mandrel (42) around said axis.

24. The mandrel according to any of the preceding claims, wherein the mandrel (42) comprises at the rear end a biasing means adapted to assure a tight fit between the body and the jacket.

25. The mandrel according to any of the preceding claims, wherein the biasing means comprises at least one spring.

26. A system for producing a glass rod or tube with a Danner blow tube according to anyone of the preceding claims 1 to 19 comprising further a nozzle for dispensing a flow of glass to the surface of the Danner blowpipe at one end of said blowpipe at a relatively

high temperature in order to form a glass film, which is removed or pulled at the other end in form of a bulb.

27. A Method, particularly for producing a glass tube or rod with a Danner blow tube according to anyone of the preceding claims 1 to 26.

28. Use of the mandrel, the system and/or the method according to any of the respective preceding claims for producing a glass tube or rod.

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53
30. Okt. 2003

Abstract

The present invention relates to a mandrel for producing glass tubes or rods, particularly for the Vello process, the A-drawing process and preferably for the Danner process. The mandrel comprises a body (1) of a ceramic composite material, and an external metal material jacket (2) surrounding at least a portion of said body, wherein the ceramic composite material has a substantially similar thermal expansion coefficient as the metal material of said jacket.

EPO - Munich
53
30. Okt. 2003

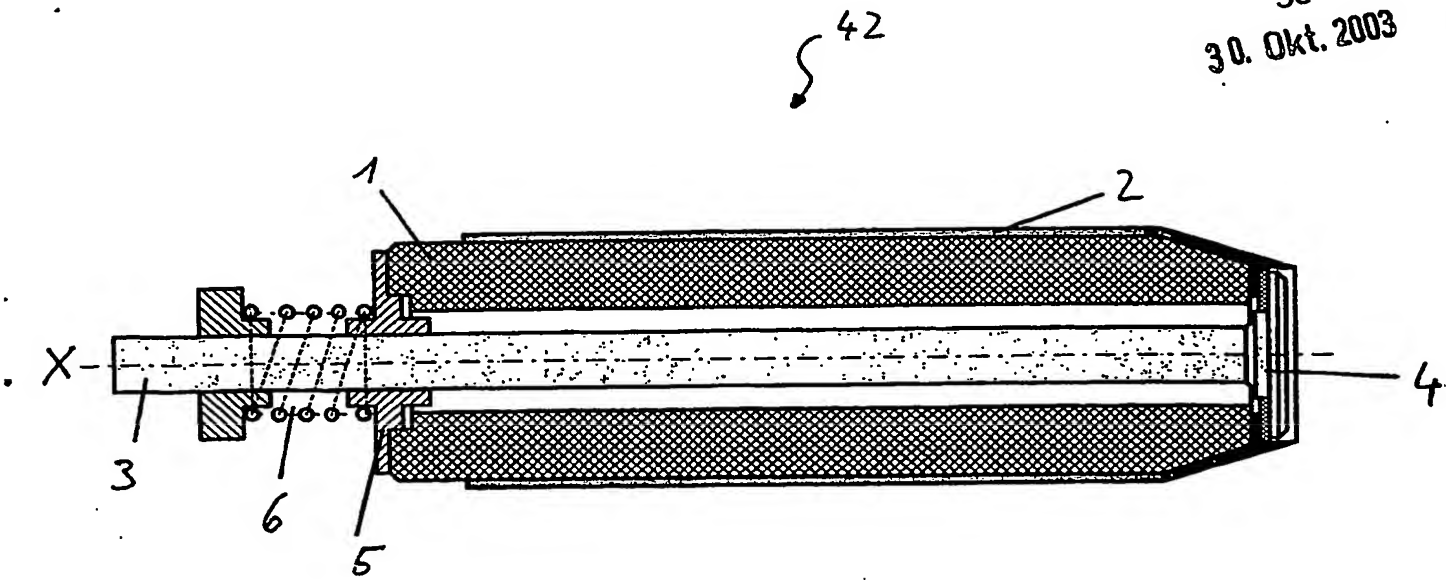

Fig. 1

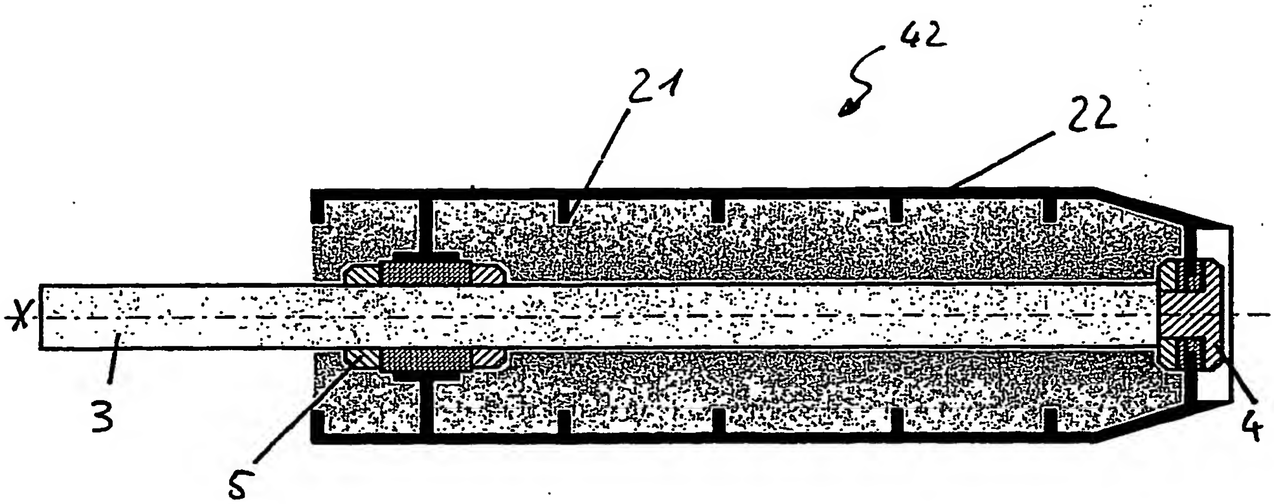

Fig. 2

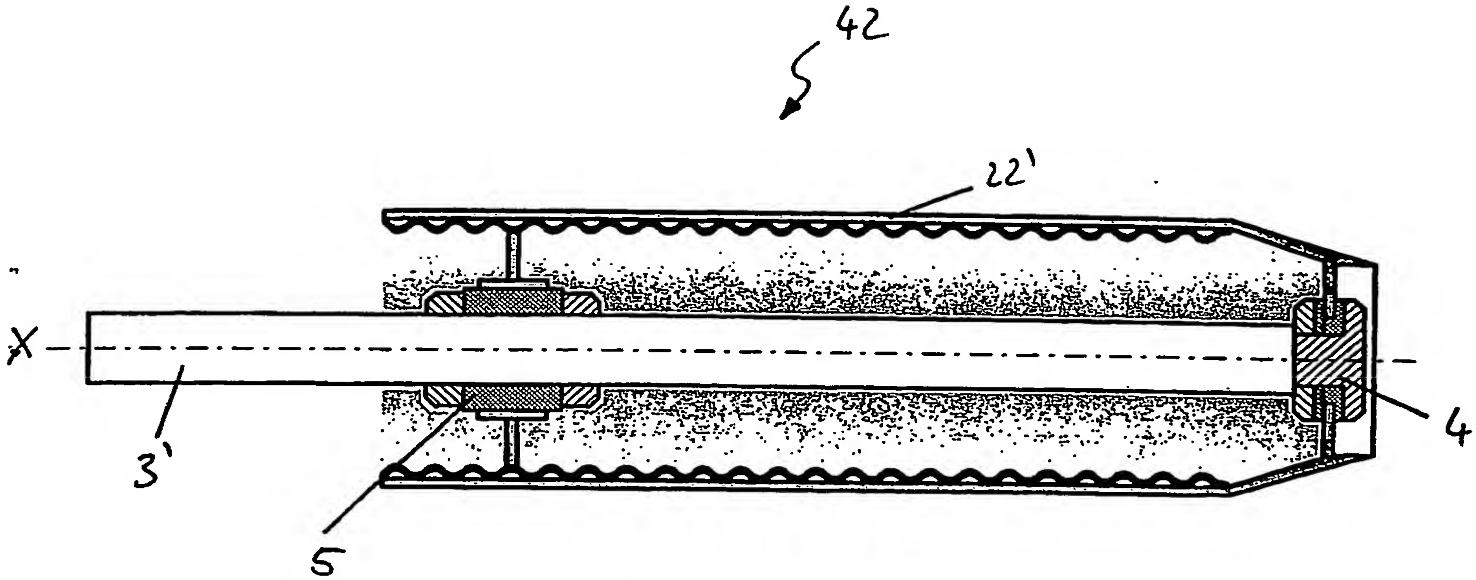

Fig. 3

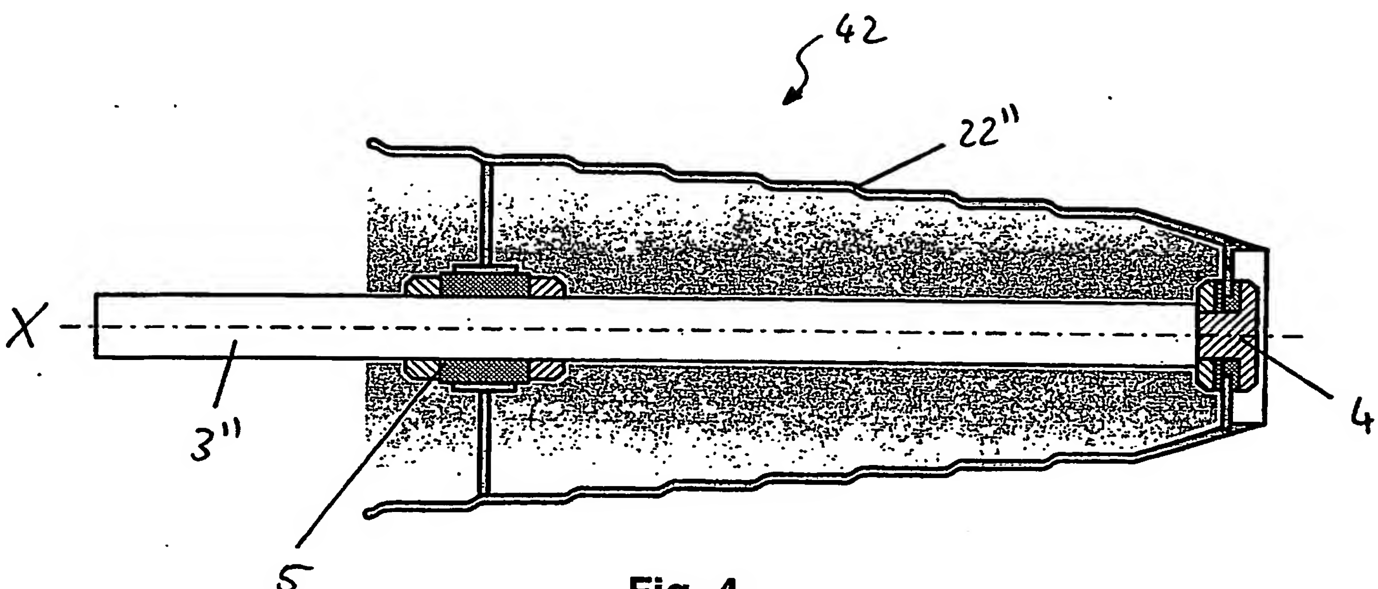

Fig. 4